STRATIGRAPHY AND PALYNOLOGY OF THE TURA FORMATION IN THE TYPE AREA PART-II (DESCRIPTIVE PALYNOLOGY)

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ABSTRACT

The present paper deals with the spores and pollen grains recovered from the various geological sections of the Tura Formation exposed in Garo Hills. The palynological assemblage comprises 88 species assignable to 51 genera. Out of these, 12 species belonging to 9 genera are new. The assemblage is dominated by angiosperms comprising monocolpate, dicolpate, tricolpate, tricolporate polycolpate, polycolporate, monoporate, triporate and panporate pollen. Pteridophytic spores are less in number.

INTRODUCTION

TURA Formation comprises a significant rock unit in the Tertiary succession of the Garo Hills. It has been deposited on the eroded platform of Pre-Cambrian granites and gneisses and is successively overlain by Siju Limestone Formation. Sandstones, shales, mottled clays and coal are the principal rock types of this formation. They contain a very rich assemblage of plant microfossils. Detailed geology of Tura Formation has already been described in the first part of this paper. The present part deals with the systematic palynology of spores and pollen recovered from the various geological sections of this formation.

Fifteen or twenty grams of material was kept in commercial nitric acid (40%) for one day followed by a treatment of KOH solution (3%) for 30 minutes. The material was washed several times and dried on the coverglass by polyvenyl alcohol and finally mounted in bional. The unused material and slides have been preserved at the repository of the Museum, Birbal Sahni Institute of Palaeobotany, Lucknow. The spores and pollen grains reported have been treated under the morphographic system of Potonié (1956, 1958 & 1960).

DESCRIPTIVE PALYNOLOGY

Anteturma — *SPORITES* H. Potonié
Turma — *TRILETES* (Reinsch) Potonié & Kremp, 1954
Subturma — *AZONOTRILETES* Luber, 1935
Infraturma — *LAEVIGATI* (Bennie & Kidston) Potonié, 1956

Genus — *Dandotiaspora* Sah, Kar & Singh, 1971

Type Species — *Dandotiaspora* (*Psilatriletes*) *dilata* (Mathur) Sah, Kar & Singh, 1971.

Dandotiaspora dilata Sah, Kar & Singh 1971

Dandotiaspora plicata (Sah & Kar) Sah, Kar & Singh, 1971

Dandotiaspora telonata Sah, Kar & Singh, 1971

Dandotiaspora densicorpa Sah, Kar & Singh, 1971

Dandotiaspora pseudoauriculata Sah, Kar & Singh, 1971

Genus — *Deltoidospora* emend. Potonié, 1956

Type Species — *Deltoidospora hallii* Miner, 1935.

Deltoidospora plicata sp. nov.

Pl. 1, figs. 1, 5

Holotype — Pl. 1, fig. 5, size 52 μ, slide no. 4874.

Type Locality — Nongwal Bibra, Garo Hills, Assam.

Diagnosis — Spores triangular, trilete, rays associated with narrow folds on distal side. Exine laevigate.

Description — Spores 25-52 μ generally triangular, apices ± acutely rounded, inter-

apical margins straight to slightly concave. Trilete rays mostly distinct, extending from 2/3-3/4 spore radius, commissures well recognisable. Well developed folds on distal side just opposite the trilete rays, simulating well developed broad rays.

Comparison — The present species is distinguishable from all the known species of *Deltoidospora* by its well developed distal folds opposite the trilete rays.

Genus — *Cyathidites* Couper, 1953

Type Species — *Cyathidites australis* Couper 1953

Cyathidites minor Couper, 1953

Pl. 1, fig. 2

1962 — *Leiotriletes dehiscenci* Baksi, p. 16, pl. 1, fig. 1.

Description — Spore mostly subtriangular, 40 μ, apices broadly rounded, inter-apical margin straight to slightly convex. Trilete rays slightly raised, uniformly broad, extending 2/3 spore radius. Exine 2-2·5 μ thick, laevigate.

Remarks — *Leiotriletes dehiscenci* Baksi (1962) from the Simsang River section, Garo Hills, Assam is similar to the present species in shape and also in size range.

Genus — *Stereisporites* Pflug, 1953

Type Species — *Stereisporites megastereoides* Pflug, 1953.

Stereisporites psilatus (Ross) Pflug, 1953

Pl. 1, fig. 13

Remarks — Spore triangular to subtriangular, 56 μ, apices rounded, inter-apical margin straight to slightly concave. Trilete rays extending up to 3/4 radius. Exine up to 1·5 μ thick, laevigate.

Stereisporites sp.

Pl. 1, fig. 3

Description — Spore triangular, 44 μ, apices bluntly rounded, inter-apical margin ± straight. Trilete rays extending 1/2 radius. Exine about 1·5 μ thick, laevigate, folded at margin, incipient thickening of the exine simulating inner body traceable.

Comparison — *Stereisporites psilatus* (Ross) Pflug (1953) resembles the present specimen in shape and size range, the latter is, however, distinguishable by the presence of an inner body like thickening.

Genus — *Leiotriletes* Naumova ex Potonié & Kremp, 1954

Type Species — *Leiotriletes sphaerotriangulus* (Loose) Potonié & Kremp, 1954.

Leiotriletes punctatus sp. nov.

Pl. 1, figs. 4, 9, 10

Holotype — Pl. 1, fig. 10, size 50 μ, slide no. 3675.

Type Locality — Nongwal Bibra, Garo Hills, Assam.

Diagnosis — spores triangular to subtriangular, trilete, 45-60 μ, exine laevigate, intrapunctate in inter-radial areas.

Description — Spores generally subtriangular with very broad apices and slightly convex, interapical margin. Trilete rays closed or open, extending up to 2/3 radius. Exine up to 2 μ thick, intrapunctate structure in the inter-radial areas generally very distinct.

Comparison — *Leiotriletes garoensis* Baksi (1962) and *L. dwarfii* Baksi (1962) resemble the present species in shape and size range. The present species is, however, distinguished by its distinct intrapunctate structure in the inter-radial areas.

Genus — *Lygodiumsporites* Potonié, Thomson and Thiergart emend Potonié, 1956

Type Species — *Lygodiumsporites* (*Punctatisporites*) *adriennis* Potonié, Thomson & Thiergart 1950.

Lygodiumsporites eocenicus Dutta & Sah, 1970

Pl. 1, fig. 27

Remarks — Spores subtriangular to subcircular, 60-90 μ. Trilete, rays well developed, closed or open, extending 2/3 radius. Exine psilate or intra-structured.

Genus — *Todisporites* Couper, 1958

Type Species — *Todisporites major* Couper, 1958.

Todisporites sp.

Pl. 1, fig. 25

Description — Spores subcircular to circular, 100-112 μ. Trilete, rays short, lips broad, extending less than 1/4 spore radius. Exine laevigate, sometimes very weakly intrastructured.

Comparison — *Todisporites kutchensis* Sah & Kar (1969) is comparable to the present species in shape and size range; the present species is, however, distinguished by its broad rays which do not extend more than 1/4 radius. *T. crassus* Sukh-Dev (1959) is distinguishable from the present species by the extension of trilete rays up to the margin.

Genus — *Gleicheniidites* Ross emend Delcourt & Sprumont, 1955

Type Species — *Gleicheniidites senonicus* Ross, 1949.

Gleicheniidites sp.

Pl. 1, fig. 22

Description — Spore subtriangular, 60 μ, apices broadly rounded, inter-apical margin ± convex. Trilete rays extending 3/4 radius. Exine about 2 μ thick, laevigate, inter-radial area intrapunctate. Exine distally thickened at each inter-radial area.

Comparison — *Gleicheniidites senonicus*, Ross (1949) is smaller in size range and has no intrapunctate exine in the inter-radial area (Singh, 1964). *Gleicheniidites* sp. described by Sah and Kar (1969) resembles the present specimen in shape, but is much smaller in size. *Gleicheniidites indicus* Singh, Srivastava & Roy (1964) is smaller in size and has laevigate exine.

Genus — *Biretisporites* Delcourt & Sprumont emend Delcourt, Dettmann & Hughes, 1963

Type Species — *Biretisporites potonaei* Delcourt & Sprumont, 1955.

Biretisporites sp.

Pl. 1, fig. 6

Description — Spore subcircular, 48 μ, trilete rays well developed, extending up to three-fourths. Exine 1·5 μ thick, laevigate.

Comparison — *Biretisporites bellus* Sah & Kar (1969) closely resembles the present species in size and prominent trilete rays, latter is, however, distinguished by its subcircular shape and the extension of trilete up to 3/4 radius. *B. convexus* Sah & Kar (1969) is more or less subtriangular and the trilete rays are comparatively well developed than the present species.

Infraturma — *APICULATI* (Bennie & Kidston) Potonié, 1956

Genus — *Osmundacidites* Couper, 1953

Type Species — *Osmundacidites wellmanii* Couper, 1953.

Osmundacidites sp.

Pl. 1, fig. 8

Description — Spore subcircular, 35 μ, trilete distinct, rays unequal, reaching more than 1/2 spore radius. Exine 1-1·5 μ thick, granulose, grana closely placed up to 1 μ high.

Comparison — *Osmundacidites kutchensis* Sah & Kar (1969) closely approximate the present species in shape and size range; but the former is distinguished by its sparsely placed grana. *O. wellmanii* Couper (1953) resembles the present species in closely placed sculptural elements, but is differentiated by its trilete rays which extend almost up to margin.

Infraturma — *MURONATI* Potonié & Kremp, 1954

Genus — *Lycopodiumsporites* Thiergart, 1938

Type Species — *Lycopodiumsporites agathoecus* (Potonié) Thiergart, 1938.

Lycopodiumsporites palaeocenicus Dutta & Sah, 1970

Pl. 1, figs. 11, 12, 16, 18

Description — Spores triangular to roundly triangular, 35-60 μ, apices broadly rounded, inter-apical sides slightly convex. Trilete distinct, long and straight, sometimes reaching the equator, often provided with folds. Exine more than 1 μ thick, reticulate, muri thin, usually projecting outside the equator due to lateral pressing; lumina irregular to polygonal in shape, ± 2 μ across.

Remarks — The spores assignable to the present species are sometimes folded in the inter-radial area. The spores described as *Reticulatisporites* sp. by Ghosh (1969) are also assignable to *L. palaeocenicus*. Some of the spores show a perine layer.

Lycopodiumsporites speciosus Dutta & Sah, 1970

Pl. 1, figs. 7, 15, 23

Description — Spores triangular, 40-50 μ, apices rounded, inter-apical margin straight to convex. Trilete rays mostly extending up to equator. Exine 2-4 μ thick, proximally laevigate, distally foveoreticulate, reticulum formed of small meshes, lumina circular and deep.

Remarks — The specimens described as *Stenozonotriletes kaufmanii* by Biswas (1962) and also by Ghosh (1969) from the Tertiary sediments of Garo Hills are perhaps also assignable to the present species. It may be mentioned here that *Stenozonotriletes* was instituted to accommodate cingulate subcircular spores. The Garo Hills specimens do not show any definite cingulum; in some specimens though, due to the thickness of the exine, they may have a pseudocingulate appearance.

Lycopodiumsporites sp.

Pl. 1, fig. 19

Description — Spore subtriangular, 45 μ, apices rounded, inter-apical margin ± convex. Trilete rays extending 2/3 radius. Exine up to 2·5 μ thick, laevigate on proximal side, distally muri strongly built forming irregular reticulum.

Comparison — *Lycopodiumsporites palaeocenicus* Dutta & Sah (1970) closely resembles the present specimen in shape, size and nature of ornamentation; but the latter is distinguished by its strongly built muri forming an irregular reticulum

Genus — *Foveotriletes* v.d. Hammen Potonié, 1956

Type Species — *Foveotriletes scrobiculatus* (v.d. Hammen) Potonié, 1956.

Foveotriletes pachyexinosus Dutta & Sah, 1970

Genus — *Reticulatisporites* Ibrahim ex Potonié & Kremp, 1954

Type Species — *Reticulatisporites parvogranulatus* Potonié & Kremp, 1954.

Reticulatisporites incompositus Dutta & Sah, 1970

Genus — *Sestrosporites* Dettmann, 1963

Type Species — *Sestrosporites irregulatus* (Couper) Dettmann, 1963.

Sestrosporites dettmannii Dutta & Sah, 1970

Genus — *Cicatricosisporites* Potonié & Gelletich, 1933

Type Species — *Cicatricosisporites dorogensis* Potonié & Gelletich, 1933.

Cicatricosisporites macrocostatus (Baksi) Sah & Dutta, 1968

Pl. 1, fig. 21

Description — Spores subtriangular in proximodistal view, 40-80 μ, apices broadly rounded, inter-apical margin convex. Trilete rays extending up to 3/4 spore radius. Exine 2-3 μ, thick proximally laevigate, distally ridged. Ridges well developed, regular.

Remarks — *Cicatricosisporites macrocostatus* described by Sah & Dutta (1969) from the Tertiary of Assam has somewhat ill-developed irregular ridges.

Subturma — *ZONOTRILETES* Waltz, 1935

Infraturma — *CINGULATI* Potonié & Klaus, 1954

Genus — *Lycospora* Schopf, Wilson & Bentall, 1944

Type Species — *Lycospora micropapillata* (Wilson & Coe) Schopf, Wilson & Bentall, 1944.

Lycospora sp.

Pl. 1, figs. 14, 17, 20

Description — Spores cingulate, 35-60 μ, triangular to subtriangular, apices broadly rounded, inter-apical margin straight to convex. Exine proximally laevigate, distally verrucose or irregularly reticulate.

Comparison — The present species is differentiated by other known species of *Lycospora* by its verrucose to irregularly meshed reticulum on the distal surface.

Turma — *MONOLETES* Ibrahim, 1933
Subturma — *AZONOMONOLETES* Luber, 1955
Infraturma — *LAVIGATOMONOLETI* Dybova & Jachovicz, 1957

Genus — *Laevigatosporites* Ibrahim, 1933

Type Species — *Laevigatosporites vulgaris* (Ibrahim) Potonié & Kremp, 1956.

Laevigatosporites lakiensis Sah & Kar, 1969

Genus — *Monolites* Erdtman et Potonié, 1956

Type Species — *Monolites* major (Cookson) Potonié, 1956.
Monolites mawkmaensis Sah & Dutta, 1966

Monolites sp.

Pl. 1, fig. 24

Description — Spore oval, 68 μ. Monolete strongly built, lip uniformly broad, extending 3/4 longer axis. Exine 2·5 μ thick, laevigate.

Comparison — *Monolites mawkmaensis* Sah & Dutta (1966) is distinguished from the present specimen by thinner exine and small size range. *Monolites* sp. described by Sah and Kar (1969) closely resembles the present specimen in size and thickness of the exine.

Monolites sp. cf. *M. discordatus* Pflug, 1953

Pl. 1, fig. 26

Description — Spore more or less subcircular, 75 μ. Monolete ill-developed, extending less than 1/2 of longer axis. Exine 1 μ thick and laevigate.

Infraturma — *SCULPTATOMONOLETI* Dybova & Jachovicz, 1957

Genus — *Polypodiisporites* Potonié, 1934

Type Species — *Polypodiisporites favus* (Potonié) Potonié, 1934.
Polypodiisporites speciosus Sah, 1967
Polypodiisporites oligocenicus Sah & Dutta, 1968

Genus — *Schizaeoisporites* (Potonié) Potonié, 1960

Type Species — *Schizaeoisporites eocaenicus* (Selling) Potonié, 1956.
Schizaeoisporites digitatoides (Cookson) Potonié, 1960

Anteturma — *POLLENITES* R. Potonié, 1931
Turma — *SACCITES* Erdtman, 1947
Subturma — *DISACCITES* Cookson, 1947
Infraturma — *PODOCARPODITI* Potonié, Thomson & Thiergart, 1950

Genus — *Podocarpidites*' Cookson emend Potonié, 1958

Type Species — *Podocarpidites ellipticus* Cookson, 1947.

Podocarpidites sp.

Pl. 2, fig. 46

Description — Pollen grains bisaccate, bilaterally symmetrical, 80-90 × 60-40 μ. Central body indistinct, probably vertically oval. Proximal attachment of sacci equatorial, distal attachment closely placed, hardly leaving any space for sulcus. Sacci subspherical, coarsely reticulate.

Comparison — *Podocarpidites khasiensis* Dutta & Sah (1970) resembles closely to the present specimens in size range, but is distinguished by its boat-shaped sulcus.

Turma — *ALETES* Ibrahim, 1933
Subturma — *AZONALETES* (Luber) Potonie & Kremp, 1954
Infraturma — *SUBPILONAPITI* (Erdtman) Vimal, 1952

Genus — *Retipilonapites* Ramanujam, 1966

Type Species — *Retipilonapites arcotense* Ramanujam, 1966.

Retipilonapites arcotense Ramanujam, 1966

Retipilonapites sp.

Pl. 2, fig. 45

Description — Pollen grain subcircular, 60 μ, nonaperturate. Sculptured with pila cum bacula, 3-4 μ long, 1·5-2·5 μ broad; closely placed, providing pseudoreticulate appearance.

Comparison — The present species is distinguished from *Retipilonapites arcotense* Ramanujam (1966) in having pila cum bacula as exine sculpture.

Genus — *Laricoidites* Potonie' Thomson & Thiergart, 1950

Type Species — *Laricoidites magnus* Potonié Thomson & Thiergart, 1950.

Laricoidites magnus Potonié, Thomson & Thiergart, 1950

Laricoidites sp.

Pl. 2, fig. 44

Description — Pollen grain subcircular to circular, 60 μ, nonaperturate. Exine moderately thick, stratification not clear, laevigate, with a distinct peripheral fold.

Comparison — The present grain approximates *Laricoidites magnus* in shape and size as well as in the organisation of secondary foldings, but differ in possessing only one peripheral fold instead of many small secondary folds.

Infraturma — *RETICULONAPITI* (Erdtman) Vimal, 1952

Genus — *Assamialetes* Singh, 1975

Type Species — *Assamialetes* (*Retialetes*) *emendatus* (Sah & Dutta) Singh, 1975).

Assamialetes sp.

Pl. 2, fig. 28

Description — Pollen grain circular, 48 μ, zonisulcate, sulcus not distinct. Exine 2-2·5 μ thick, stratification not clear, surface ornamentation microreticulate.

Comparison — The present specimen differs from *Assamialetes emendatus* Singh (1975) by its much smaller size and fine reticulation.

Turma — *PLICATES* (Naumova) Potonié, 1960
Subturma — *MONOCOLPATES* Iversen & Troel-Smith, 1950
Infraturma — *RETECTINES* (Malawkina) Potonié, 1958

Genus — *Couperipollis* Venkatachala & Kar, 1969

Type Species — *Couperipollis perspinosus* (Couper) Venkatachala & Kar, 1969.

Couperipollis perspinosus (Couper) Venkatachala & Kar, 1969

Couperipollis rarispinosus (Sah & Dutta) Venkatachala & Kar, 1969

Pl. 2, figs. 33, 39

Remarks — Pollen grain mostly subcircular, sometimes broadly oval, monocolpate, colpus distinct or indistinct, extending from one end to other. Exine 1·5-2·5 μ thick, sometimes irregularly folded. Sculptured with bulbous spines, spines sparsely placed, 3-8 μ apart.

Couperipollis brevispinosus (Biswas) Venkatachala & Kar, 1969

Pl. 2, fig. 42

Remarks — Pollen grains subcircular to circular, 30-40 μ. Colpus distinct or indistinct, extending from one end to other. Exine up to 2 μ thick, spinose, spines 3-5 μ long, mostly with bulbous base and pointed tips, closely placed and evenly distributed.

Couperipollis wodehousei (Biswas) Venkatachala & Kar, 1969

Couperipollis sp. cf. *C. wodehousei* (Biswas) Venkatachala & Kar, 1969

Pl. 2, figs. 29, 30

Description — Pollen grains subcircular, 45-55 μ. Monocolpate, colpus extending from end to end, sometimes indistinct. Exine 1-2 μ thick, spinose, inter-spinal space laevigate to slightly granulose.

Couperipollis duttae sp. nov.

P. 2, figs. 31, 36

1970 — *Monosulcites* sp. Dutta & Sah, p. 25, pl. 5, fig. 3.

Holotype — Pl. 2, fig. 31, size 70 μ, slide no. 3666.

Type Locality — Nongwal Bibra, Garo Hills, Assam.

Diagnosis — Pollen grains oval to elliptical. Monocolpate, colpus extending from end to end, associated with fold on either side. Exine very sparsely spinose, inter-spinal space granulose.

Description — Pollen grains mostly oval with equally broad rounded ends, 58-70 μ. Colpus mostly indistinct, well developed folds on each side of the colpus, sometimes overlapping each other. Exine up to 2 μ thick, spines delicate, 2-4 μ long, 8-12 μ apart. Inter-spinal grana well developed, about 1 μ high, closely placed.

Comparison — *Couperipollis perspinosus* (Couper) Venkatachala & Kar (1969) closely resembles the present species in shape and distribution of the spines. The present species is, however, distinguishable by the presence of folds on each side of the colpus, and granular exine in between the spines. *C. rarispinosus* Venkatachala & Kar (1969) is mostly subcircular in shape. *C. brevispinosus* (Biswas) Venkatachala & Kar (1969) besides being subcircular to circular in shape also has not closely placed spines.

Derivation of Name — After Dr. S. K. Dutta, Dibrugarh University, Dibrugarh, Assam.

Couperipollis ovatus sp. nov.

P. 2, figs. 34, 35

Holotype — Pl. 2, fig. 34, size 30 μ, slide no. 3731.

Type Locality — Nongwal Bibra, Garo Hills, Assam.

Diagnosis — Pollen grains oval, 30-38 μ. Monocolpate, colpus extending from end to end. Exine spinose, spine sparsely distributed, 6-12 μ long, inter-spinal space laevigate.

Description — Pollen grains mostly with equally broad lateral ends. Colpus distinct or indistinct. Uniformly broad or slightly constricted. Spines straight or slightly bent with pointed tips, 5-10 μ apart.

Comparison — *Couperipollis duttae* sp. nov. is distinguished from the present, specimens by its larger size and granulose inter-spinal space, *C. rarispinosus* (Sah & Dutta) Venkatachala & Kar (1969) and *C. perspinosus* (Couper) Venkatachala & Kar (1969) differ from the present species in having comparatively short spine.

Couperipollis sp. 1

Pl. 2, figs. 32, 37, 38

Description — Pollen grains large, oval to subcircular, 50-70 μ. Monosulcate, sulcus long, widely open, usually indistinct due to spinose exine ornamentation. Spines with bulbous base and long pointed apices.

Comparison — Although present grains show a superficial resemblance with *Couperipollis* sp. cf. *C. wodehousei*, but differ in having a wide sulcus.

Couperipollis sp. 2

Pl. 2, figs. 40, 43

Description — Pollen grains quite large, oval to elliptical in shape, 80-100 μ. Monosulcate, suclus long, usually close, extending end to end. Exine ornamentation spinose, spines short and conical, measuring 2-3 μ long.

Comparison — The present grains show a superficial resemblance with *Monocolpites ellii* van der Hammen (1954) but due to lack of a published description of the species, a definite comparison is not possible.

Genus — *Liliacidites* Couper, 1953

Type Species — *Liliacidites kaitangataensis* Couper, 1953

Liliacidites intermedius Couper, 1953
Liliacidites microreticulatus Dutta & Sah, 1970

Liliacidites giganticus sp. nov.

Pl. 3, figs. 54-56

Holotype — Pl. 3, fig. 55, size 140 μ, slide no. 3655.

Type Locality — Nongwal Bibra, Garo Hills, Assam.

Diagnosis—Pollen grains oval to elliptical, 100-145 μ. Monosulcate, sulcus extending end to end. Exine pitted to retibaculate.

Description — Pollen grains with broad or pointed lateral ends. Sulcus distinct or indistinct, uniformly broad or boat-shaped. Exine 2-3·5 μ thick. Sexine as thick as nexine, bacula well developed, retibaculate patern sometimes strongly built, lumina shallow.

Comparison — The present species is distinguished from all the known species of the genus by its very large size.

Liliacidites major sp. nov.

Pl. 3, figs. 51-53

Holotype — Pl. 3, fig. 51, size 100 μ, slide no. 4874.

Type Locality — Nongwal Bibra, Garo Hills, Assam.

Diagnosis — Pollen grains oval, 78-100 Monosuclate, sulcus distinct to indistinct, Exine pitted to retibaculate.

Description — Pollen grains mostly oval with unequally broad lateral ends. Sulcus mostly extending from pole to pole, uniformly broad or constricted at one pole. Exine 2-3 μ thick, sexine as thick as nexine. Exine apparently pitted with bacular heads. In some specimens bacula interwoven together to form a retibaculate pattern.

Comparison — *Liliacidites microreticulatus* Dutta & Sah (1970) is comparable to the present species in its shape, size range and broad sulcus but the latter is distinguished by its retibaculate exine. *L. ellipticus* Venkatachala & Kar (1969) and *L. baculatus* Venkatachala & Kar (1969) are much smaller in size than the present species.

Infraturma — *MONOPTYCHES* (Naumova) Potonié, 1958

Genus — *Palmaepollenites* Potonié, 1951

Type Species — *Palmaepollenites tranquilus* Potonié, 1951.
Palmaepollenites communis Sah & Dutta, 1966
Palmaepollenites eocenicus Sah & Dutta, 1966

Genus — *Palmidites* Chitaley ex Couper, 1953

Type Species—*Palmidites maximus* Couper, 1953.
Palmidites maximus Couper, 1953

Palmidites plicatus sp. nov.

Pl. 3, figs. 47-50

Holotype — Pl. 3, fig. 50, size 120 μ, slide no. 4715.

Type Locality — Nongwal Bibra, Garo Hills, Assam.

Diagnosis — Pollen grains oval to elliptical, 98-120 μ. Monocolpate, colpus generally extending from end to end, associated with folds on each side. Exine laevigate.

Description — Pollen grains mostly with pointed lateral ends. Monocolpate, colpus generally distinct, sometimes indistinct due to overlapping of the associated folds. Folds well developed, extending throughout the colpus. Exine 1-2 μ thick, laevigate, sometimes slightly intrastructured.

Comparison — *Palmidites maximus* Chitaley ex Couper (1953) is comparable to present species in shape, but the later is distinguished by its higher size and association of folds along the colpus.

Palmidites assamicus sp. nov.

Pl. 4, figs. 74, 76

Holotype — Pl. 4, fig. 74, size 60 μ, slide no. 4904.

Type Locality — Nongwal Bibra, Garo Hills, Assam.

Diagnosis — Pollen grains oval, 55-65 μ. Monocolpate, colpus very broad. Exine laevigate.

Description — Pollen grains mostly with equally rounded lateral ends. Monocolpate, colpus distinct, extending from end to end, 15-25 μ, broad. Exine 1-2 μ thick, sometimes weakly intrastructure.

Comparison — *Palmidites maximus* Couper (1953) is comparable to the present species in shape and extension of colpus from one end to the other. The former is, however, distinguished by its bigger size range.

Infraturma — *SPHAEROZONISULCATES* Venkatachala & Kar, 1969

Genus — *Proxapertites* v.d. Hammen, 1956

Type Species — *Proxapertites operculatus* v.d. Hammen, 1956.

Proxapertites crassimurus (Sah & Dutta) Singh, 1975

Proxapertites granulatus sp. nov.

Pl. 4, figs. 64, 65, 68

Holotype — Pl. 4, fig. 64, size 44 μ, slide no. 4719.

Type Locality — Nongwal Bibra, Garo Hills, Assam.

Diagnosis — Pollen grains subcircular to circular, 46-50 μ, zonisulcate. Exine granulose.

Description — Pollen grains mostly subcircular or broadly oval. Sulcus mostly distinct sometime indistinct, parallel to margin. Sulcus continuous or discontinuous at one or two places. Exine up to 2 μ thick, granulose grana up to 1 μ high, closely placed and uniformly distributed.

Comparison — The present species closely resembles *Proxapertites assamicus* (Sah & Dutta) Singh, 1975 in size range, shape and zonisulcate condition. It is, however, distinguished by its granulose exine. *P. marginatus* (Venkatachala & Kar) Singh, 1975 and *P. crassimurus* (Sah & Dutta) Singh, 1975 are both reticulate species.

Subturma — *TRYPTYCHES* (Naumova) Potonié, 1960

Genus — *Tricolpites* Erdtman ex Couper, 1953

Lectotype — *Tricolpites reticulatus* Cookson, 1947 designated by Couper (1953).

Remarks — Erdtman (1947) suggested an artificial system of classification of fossil and recent pollen grains and spores. He groups the pollen types in thirteen groups and, within each group, he suggested the names of the pollen, but only for discussion of questions of classifications and not for codification in nomenclature. For example, type group 6 (colpate) he suggested that the names of the pollen should be according to the number of the colpi, e.g. *Tricolpites*. Erdtman does not circumscribe the taxon, hence *Tricolpites* can not be considered as generic name proposed by him.

Cookson (1947) described two new species under the name *Tricolpites*. But she does not refer the name *Tricolpites* to Erdtman. At the same time she also does not mention if *Tricolpites* is to be considered as a new genus created by her. Couper (1953) for the first time considers *Tricolpites* as a form genus and gives diagnosis and a type species. Potonié (1960, p. 95) gives a diagnosis for the genus *Tricolpites* which is at variance with that given by Couper (1953) and it precludes some of the species described by Couper under this genus. Therefore, in the present paper Couper's diagnosis has been followed.

Tricolpites levis Sah & Dutta, 1966

Tricolpites sp.

Pl. 4, figs. 72, 77

Description — Pollen grains oval to elliptical in the equatorial view. Tricolpate, colpi long, extending from one end to other. Exine about 3 μ thick, reticulate.

Comparison — *Tricolpites alveolatus* Couper (1953) is distinguished from the present species by pilate sculptural elements. *T. waimumuensis* Couper (1953) has clavate or baculate sculptural elements.

Genus — *Stephanocolpites* v.d. Hammen emend Potonie', 1960

Type Species — *Stephanocolpites costatus* v.d. Hammen, 1954.

Stephanocolpites flavatus Venkatachala & Kar, 1969

Pl. 4, fig. 82

Remarks — Pollen grain ± subcircular, 36 μ. Tetracolpate, colpi, short, never reaching more than 1/2 pollen radius. Exine about 2 μ thick, laevigate.

Stephanocolpites sp. cf. *S. arcotense* Ramanujam, 1966

Pl. 4, figs. 73, 75

Remarks — Pollen grains ± subcircular. Tetracolpate, colpi wide and funnel shaped. Mesocolpate region wide, straight to slightly convex. Exine about 2 μ thick, granulose, grana about 1 μ high, closely placed, evenly distributed.

Stephanocolpites tertiarus sp. nov.

Pl. 4, figs. 69, 78

Holotype — Pl. 4, fig. 87, size 60 μ, slide no. 3671.

Locality — Damalgiri, Garo Hills, Assam,

Diagnosis — Pollen grains subcircular. 45-60 μ. Tetracolpate, colpi short, exine 3-6 μ thick, retipilate.

Description — Pollen grains mostly subcircular, sometimes oval or squarish, margin even, or slightly constricted due to apertural openings. Colpi not reaching up to poles, narrow, sometimes closed, mesocolpia region broad. Nexine thicker than sexine. Mostly retipilate. Meshes thick, lumina shallow.

Comparison — *Stephanocolpites flavatus* Venkatachala & Kar (1969) is comparable in general organisation but is distinguished by its granulose exine. *S. arcotense* Ramanujam (1966) has long funnel-shaped colpi. *S. nadhamunii* Venkatachala & Kar (1969) approximates the present species in thick exine, but is distinguished by its granulose ornamentation.

Genus — *Polycolpites* Couper, 1953

Type Species — *Polycolpites clavatus* Couper, 1953.

Polycolpites cooksonii Sah & Dutta, 1966

Pl. 4, fig. 79

Remarks — Pollen grains circular, 25-36 μ. Polycolpate, colpi narrow, deep, extending about 1/2 pollen radius. Exine up to 2 μ thick, well differentiated into sexine and nexine, laevigate to finely granulose.

Polycolpites speciosus Dutta & Sah 1970,

Pl. 4, fig. 83

Infraturma — *PROLATI* Erdtman, 1943

Genus — *Lakiapollis* Venkatachala & Kar, 1969

Type Species — *Lakiapollis ovatus* Venkatachala & Kar, 1969.

Lakiapollis ovatus Venkatachala & Kar, 1969

Lakiapollis matanamadhensis Venkatachala & Kar, 1969

Genus — *Verrucolporites* Sah & Kar, 1970

Type Species — *Verrucolporites verrucus* Sah & Kar, 1970.

Verrucolporites verrucus Sah & Kar, 1970

Genus — *Bombacacidites* Couper, 1960

Type Species — *Bombacacidites bombaxoides* Couper, 1960.

Bombacacidites clarus Sah, 1967

Genus — *Rhoipites* Wodehouse, 1933

Type Species — *Rhoipites bradleyi* Wodehous 1933.

cf. *Rhoipites* sp.

Pl. 4, fig. 71

Description — Pollen grain subtriangular, 40 μ, with convex margins, tricolporate, colpi short, colpi margin thin, pore ± distinct. Exine 1·5 μ thick, laevigate.

Remarks — The present specimen shows all the general characters of *Rhoipites* Wodehouse (1933). It is, however, preserved in polar view whereas the known grains of *Rhoipites* are mostly in equatorial view. As such a comparison at specific level could not be made.

Genus — *Meliapollis* Sah & Kar, 1970

Type Species — Meliapollis ramanujamii Sah & Kar, 1970.

Meliapollis ramanujamii Sah & Kar, 1970
Meliapollis minutus sp. nov.

Pl. 4, figs. 57, 63, 67

Holotype — Pl. 4, fig. 9, size 36 μ, slide no. 3755.

Type Locality — Nongwal Bibra, Garo Hills, Assam.

Diagnosis — Pollen grains squarish to oval 28-35 μ. Tetracolporate, colpi small, pore margin thickened. Exine ± laevigate.

Description — Pollen grains mostly squarish in outline, sometimes rhomboidal or oval. Colpi not more than 10 μ long, indistinct. Pore distinct, margin uniformly thickened. Exine about 2 μ thick, laevigate, sometimes weakly infrastructured.

Comparison — Meliapollis ramanujamii Sah & Kar (1970) is distinguished by its subcircular shape and bigger size range. *M. raoi* Sah & Kar (1970) and *M. navalei* Sah & Kar (1970) have tricolporate and pentacolporate conditions respectively.

Infraturma — *SPHAEROIDATI* Erdtman, 1943

Genus — *Nyssapollenites* Thiergart, 1937

Type Species — Nyssapollenites pseudocruciatus (Potonié) Thiergart, 1937.

Nyssapollenites barooahii Sah & Dutta, 1968.

Genus — *Favitricolporites* Sah, 1967

Type Species — Favitricolporites eminens Sah, 1967.

Favitricolporites complexus Sah & Dutta, 1968.

Genus — *Margocolporites* Ramanujam, 1966

Type Species — Margocolporites tsukadae Ramanujam, 1966.

Margocolporites tsukadae Ramanujam, 1966
Margocolporites complexum Ramanujam, 1966.

Margocolporites sitholeyi Ramanujam, 1966.

Genus — *Palaeocaesalpinaceaepites* Biswas, 1962

Type Species — Palaeocaesalpinaceaepites eocenicus Biswas, 1962.

Palaeocaesalpinaceaepites eocenicus Biswas, 1962

Pl. 4, fig. 85

Remarks — Pollen grains ± subcircular, 60-80 μ. Tricolporate colpi long, colpi margin thickened, colpi membrane laevigate. Exine up to 2·5 μ thick, baculate, bacula thicker, forming negative reticulum in surface view.

Genus — *Compositoipollenites* Potonié, 1951

Type Species — Compositoipollenites rizophorus Potonié, 1951.

Compositoipollenites argutus Sah, 1967

Infraturma — *OBLATI* Erdtman, 1943

Genus — *Symplocospollenites* Potonié, Thomson & Thiergart, 1950

Type Species—Symplocospollenites rotundus Potonié, Thomson & Thiergart, 1950.

Symplocospollenites granulatus sp. nov.

Pl. 4, figs. 58, 59, 61

Holotype — Pl. 4, fig. 61, size 24 μ, slide no. 4721.

Type Locality — Nongwal Bibra, Garo Hills, Assam.

Diagnosis — Pollen grains subcircular to circular, 20-24 μ, 4-5 porate. Exine granulose.

Description — Pollen grains notched due to pores. Pores inconspicuous, 3-5 μ long, margin not thickened. Exine 1·5-2·5 μ thick. Sexine as thick as nexine, granulose, grana less than 2 μ high, not very densely placed.

Comparison — Symplocospollenites rotundus Potonié, Thomson & Thiergart (1950) resembles in shape and size range but is distinguished by its laevigate exine.

Remarks — According to Potonié *et al.* (1950) there are ill-developed colpi in *Symplocospollenites*. In our specimens, however, no colporate condition was observed.

Turma — *POROSES* (Naumova) Potonié, 1960

Subturma — *MONOPORINES* Naumova, 1937

Genus — *Graminidites* Cookson, 1947

Type Species — Graminidites media Cookson, 1947.

Graminidites sp. cf. *G. media* Cookson, 1947

Pl. 4, fig. 60

Remarks — Pollen grain subcircular, 30 μ. Monoporate, pore margin slightly thickened. Exine 2-2·5 μ thick, granulose to rugulose.

Subturma — *TRIPORINES* (Naumova) Potonié, 1960

Genus — *Triporopollenites* Pflug emend Potonié, 1960

Type Species — Triporopollenites coryloides Pflug (in Thomson & Pflug), 1953.

Triporopollenites vimalii, Sah & Dutta, 1966

Genus — *Myrtaceidites* Cookson & Pike emend Potonié, 1960

Type Species — Myrtaceidites mesonesus Cookson & Pike, 1954.

Myrtaceidites sp.

Pl. 4, fig. 66

Description — Pollen grain small, 30 μ, roundly triangular. Tricolporate, syncolpate, colpi long, meeting at the poles Exine 3-4 μ thick, much thickened at sides than at pores, sexine thicker than nexine, surface ornamentation verrucose.

Comparison — The present specimen is not comparable to any species described under the genus due to its coarse ornamentation.

Genus — *Triorites* Erdtman ex Couper, 1953

Type Species — Triorites magnificus Cookson, 1950 designated by Potonié (1960).

Triorites communis Sah & Dutta, 1966

Triorites bellus Sah & Kar, 1970

Genus — *Ancolosidites* Cookson & Pike, 1954

Type Species — Ancolosidites lutoides Cookson & Pike, 1954.

Anacolosidites sp.

Pl. 4, fig. 62

Description — Pollen grains subtriangular, 30-40 μ. six-porate, 3 pores distinctly seen, remaining not clearly discernible, pore margins thickened. Exine 3-5 μ thick. Sexine thicker than nexine, intrabaculate.

Remarks — The present specimens being ill-preserved, all the pores are not distinct. The general organisation is, however, comparable to genus *Anacolosidites* Cookson & Pike (1954).

Genus — *Pseudonothofagidites* Venkatachala & Kar, 1969

Type Species — Pseudonothofagidites Kutchensis Venkatachala & Kar, 1969.

Pseudonothofagidites kutchensis Venkatachala & Kar, 1969

Genus — *Malvacearumpollis* Nagy, 1962

Type Species — Malvacearumpollis bokonyensis Nagy, 1962

Malvacearumpollis sp.

Pl. 4, fig. 86

Description — Pollen grain large, originally subcircular but oval due to folding, 138 μ. Panporate, pores well developed, ± circular, pore margin not appreciably thickened. Exine with sparse but robustly built warts, inter-wartal space of exine granulose.

Comparison — The species resembles *M. africana* Sah (1967) in shape, size and panporate condition, but is distinguished in having well developed warty processes all over the exine.

Turma — *JUGATES* (Erdtman) Potonié, 1960

Subturma — *TETRADITES* Cookson, 1947

Genus — *Droseridites* Cookson, 1947

Type Species — Droseridites spinosus Cookson, 1947.

Droseridites parvus Dutta & Sah, 1970

POLLEN TYPE-1

Pl. 4, fig. 70

Description — Pollen grain ± circular, 45 μ. Monocolporate, colpus provided with three pores, pores almost circular, 4 μ across, lalongate. Exine up to 2·5 μ thick, stratification not distinct, surface sculpturing granulose, grana closely placed, up to 1·5 μ high.

POLLEN TYPE-2

Pl. 4, fig. 80

Description — Pollen grain subcircular, 68 μ. Triporate, pores ± circular, 4-5 μ across. Exine 3-3·5 μ thick, beset with many spinose processes. Bulbous bases of spines surrounded by many baculate projections, inter-spinal space granulose.

POLLEN TYPE-3

Pl. 4, fig. 84

Description — Pollen grain broken, 65 μ, panporate, pores distinct, margin not appreciably thickened. Exine spinose, spines 6-10 μ long, robustly built, basal part of spines densely granulose to coniate giving a pseudoreticulate appearance. Remaining exine laevigate.

Remarks — The specimen closely resembles the pollen grains of the extant genus *Gossypium* belonging to the family Malvaceae.

POLLEN MASS

Pl. 4, fig. 81

1962 — *Tricolporites radiistriaei* Baksi, 1962

Description — Pollen mass circular to rounded polygonal in outline. Octad, each unit porate and tectate. Exine up to 5 μ thick, unstratified, pilate, nontegellate, pila arranged in certain rows, forming distinct striae. Surface ornamentation pseudoreticulate. *Extrema linamenta* wavy.

Remarks — Since colporate condition is not conceivable from the photograph of *Tricolporites radiistriaei* described by Baksi (1962, p. 20, pl. 5), placement of his specimen under the genus *Tricolporites* seems to be erroneous.

BOTANICAL CONSIDERATIONS

Qualitative and quantitative analyses of the palynological assemblages recovered from the various members of the Tura Formation in the type area show that pteridophytes and angiosperms form the dominant constituents while gymnospermous elements are comparatively poorly represented. The fungal and algal remains from this formation have already been published (Kar, Singh & Sah, 1972). A total of twelve species, assignable to nine genera are new. To evaluate the probable environment of deposition of Tura Formation, the botanical analysis of the palynological assemblage is discussed below.

BRYOPHYTA

There is no conclusive evidence to indicate the presence of bryophytes. *Stereisporites psilatus* may, however, be related to the mosses.

PTERIDOPHYTA

Pteridophytic spores are fairly abundant, both in numbers and variety throughout the Tura Formation. Following species belonging to 19 genera in all probability, represent the pteridophytes :

1. LYCOPODIACEAE — (i) *Lycopodiumsporites palaeocenicus*, (ii) *L. speciosus*, (iii) *Foveotriletes pachyexinous*, (iv) *Reticulatisporites incompositus*, (v) *Sestrosporites dettmanii*, (vi) *Lycospora* sp. Although the family is found in both tropical and temperate habitats it generally favours moist and shady places.

2. POLYPODIACEAE — (i) *Laevigatosporites, lakiensis*, (ii) *Monolites* sp. cf. *M. discordatus*, (iii) *M. mawkmaensis*, (iv) *Monolites* sp., (v) *Polypodiisporites speciosus*. The family is cosmopolitan, though rare in dry regions.

3. SCHIZEACEAE — (i) *Schizaeoisporites eocenicus*, (ii) *Cicatricosisporites macrocostatus*, (iii) *Lygodiumsporites eocenicus*, (iv) *Dandotiaspora dilata*, (v) *D. plicata*, (vi) *D. telonata*, (vii) *D. pseudoauriculata*, (viii) *D. densicorpa*. The latter four species have doubtful affinity. The family is common to both tropical and subtropical regions.

4. GLEICHENIACEAE — This family is represented by a single spore of *Gleicheniidites* sp. The members of this family as a rule love moist and shady habitat.

5. OSMUNDACEAE — Only a single specimen of *Osmundacidites* sp. shows morphological similarity with the family Osmundaceae. This family, like other pteridophytes is also cosmopolitan.

6. CYATHIACEAE — (i) *Cyathidites minor*, (ii) *Leiotrilites punctatus*, (iii) *Stereisporites psilatus* and *Stereisporites* sp. *Deltoidospora plicata* may also be related to the family Cyathiaceae. The present day distribution of this family is restricted to tropical and subtropical regions.

GYMNOSPERMAE

The gymnosperms are rather poorly represented in the type area. Only two species, viz., *Laricoidites magnus* and *Podocarpidites* sp. can be assigned to this group.

ANGIOSPERMAE

The large number of angiospermic genera and species indicate that angiosperms had attained a more or less dominant position during the early Tertiary times.

The angiospermous pollen have been referred (some of them doubtfully) to 28 genera. Of these, 6 genera belong to the monocotyledons while the remaining 22 genera belong to the dicotyledons.

MONOCOTYLEDONAE

Although significantly represented, as compared to dicots, the high percentage of pollen grains referable to the family Palmae, makes this class a very significant group. The following forms have been assigned to the Monocotyledonae.

1. PALMAE — The rich representation of the pollen forms referred to *Couperipollis duttae, C. ovatus, C. brevispinosus, C. wodehousei, C. perspinosus, C. rarispinosus, Palmidites plicatus, P. assamicus*, and *P. maximus* suggest that this family constitutes one of the principal monocot elements in the assemblage. The geological record of the family dates back to the Upper Cretaceous and even much older horizons. Its present day distribution is restricted to tropical and subtropical regions.

2. POTAMOGETONACEAE — The family is cosmopolitan in distribution and exclusively aquatic. It is represented by *Retipilonapites cenozoicus* and *Retipilonapites* sp.

3. LILIACEAE — (i) *Liliacidites giganticus*, (ii) *L. major*, (iii) *L. intermedius*, and (iv) *L. microreticulatus*.

4. GRAMINAE — The family is represented by a single grain *Graminidites* sp. Their paucity in the present assemblage may be due to their preference for drier situations.

DICOTYLEDONAE

The dicotyledon forms a dominant group which can be evidenced by the presence of pollen grains referable to following 17 families.

1. MENISPERMACEAE — Pollen of *Symplocospollenites granulatus* are referred to this family. The family is found chiefly in tropical regions.

2. NYMPHAEACEAE—Morphological characters of three species, *Proxapertites assamicus, P. crassimurus* and *Assamialetes emendatus* suggest undoubted relationship with the Nymphaeaceae and in all probability they represent that family. The family is chiefly tropical and favours aquatic or marshy habitats.

3. CRUCIFERAE — Definite evidence for the presence of Cruciferae is lacking. *Tricolpites levis*, could be a crucifer. The family is cosmopolitan and grow in diverse situations.

4. MALVACEAE — The distinctive grains of *Malvacearumpollis* sp. provide conclusive evidence for the presence of this family. There is so far no fossil record of this family from horizons older than Miocene. It has a tropical to subtropical distribution in India.

5. BOMBACACEAE — Pollen grains referred to *Bombacacidites clarus* represent this family. Fossil records show that the geological history of Bombacaceae dates back to the Lower Eocene. The family is chiefly tropical and well represented in present day vegetation of Garo Hills.

6. ONAGRACEAE — The presence of this family is supported by the pollen grains of *Triorites communis* and *Triorites bellus*. Pollen records show the presence of this family in early Tertiary sediments. The family is both tropical and temperate.

7. NYSSACEAE — The pollen grains of *Nyssapollenites barooahii* probably belong to this family. The species has been recorded from all the horizons of the Tura Formation.

8. RUBIACEAE — Probably represented by *Polycolpites cooksonii* and *P. speciosus*. However, their affinity remains uncertain. The family is tropical in distribution.

9. COMPOSITAE — Although this family is entomophyllous, yet, several grains referable to *Compositoipollenites argutus* have been recorded from the upper horizons of the Tura Formation.

10. MELIACEAE — Pollen grains of *Meliapollis ramanujamii* strongly suggest the presence of this family. Fossil pollen of Meliaceae are known from Eocene strata. It has a tropical to subtropical distribution.

11. CAESALPINACEAE — Three species, viz., *Margocolporites complexum, M. sitholeyi* and *M. tsukadae* have undoubted affinity with the Caesalpinaceae. Pollen grains of this family have been recorded from the Miocene sediments of India. The family is mostly tropical in distribution.

12. DROSERACEAE — Only a single species *Droseridites parvus* has been recorded from the present assemblage. Since the family is entomophyllous, the chances of preservation of the pollen grains are rare. This family is subtropical to temperate in distribution.

13. MYRTACEAE — Pollen grains referred as *Myrtaceidites* sp. indicate the presence of this chief tropical family. Fossil pollen of this family have been recorded from older Tertiary sediments.

14. MYRSINACEAE — Two species, *Stephanocolpites* sp. cf. *S. arcotense* and *S. flavatus* are assignable to this family. This species is found in almost all the horizons of Tura Formation. The family prefers subtropical to temperate habitats.

15. LABIATAE — The presence of this family is indicated by *Tricolpites reticulatus*. The family is cosmopolitan in distribution.

16. POLYGONACEAE — Pollen grains described under *Tricolpites levis* may belong to this family.

17. EUPHORBIACEAE — Two species, *Lakiapollis matanamadhensis* and *L. ovatus*, in all probability, indicate the presence of this family. The family is cosmopolitan and is found in varied situations except in arctic regions.

18. UTRICACEAE — Evidence for the presence of this family is inconclusive. Pollen grains referred to *Triporopollenites vimalii* appear to be morphologically comparable to the pollen grains met within the Utricaceae but their natural relationship remains doubtful. Utricaceae is abundantly found in temperate and tropical zone.

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EXPLANATION OF PLATES

(All magnifications × ca 500)

PLATE 1

1 & 5. *Deltoidospora plicata* sp. nov.; Slide nos. 4874 (Holotype), 4876.

2. *Cyathidites minor* Couper; Slide no. 3655.

3. *Stereisporites* sp.; Slide no. 4710.

4, 9 & 10. *Leiotriletes punctatus* sp. nov.; Slide nos. 4874, 4876 & 3675 (Holotype).

7, 15, 23. *Lycopodiumsporites speciosus* Sah & Dutta; Slide nos. 4860, 4908 & 4880.

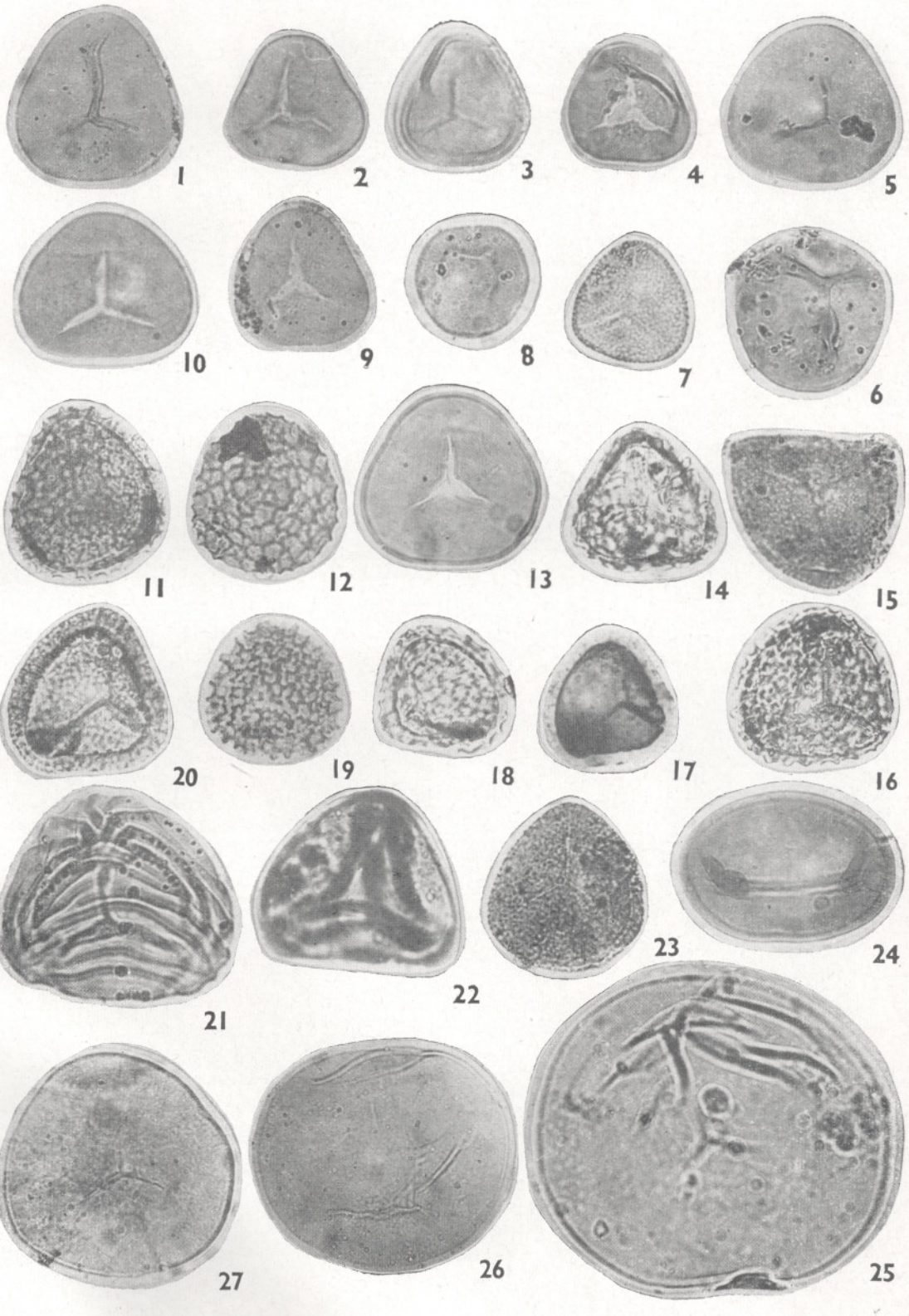
8. *Osmundacidites* Couper; Slide no. 4869.

11, 12, 16, 18. *Lycopodiumsporites palaeocenicus* Sah & Dutta; Slide nos. 4875, 4877, 4711 & 4909.

13. *Stereisporites psilatus* Pflug; Slide no. 3673.

14, 17 & 20. *Lycospora* sp.; Slide nos. 4874, 3685 & 4711.

19. *Lycopodiumsporites* sp.; Slide no. 4857.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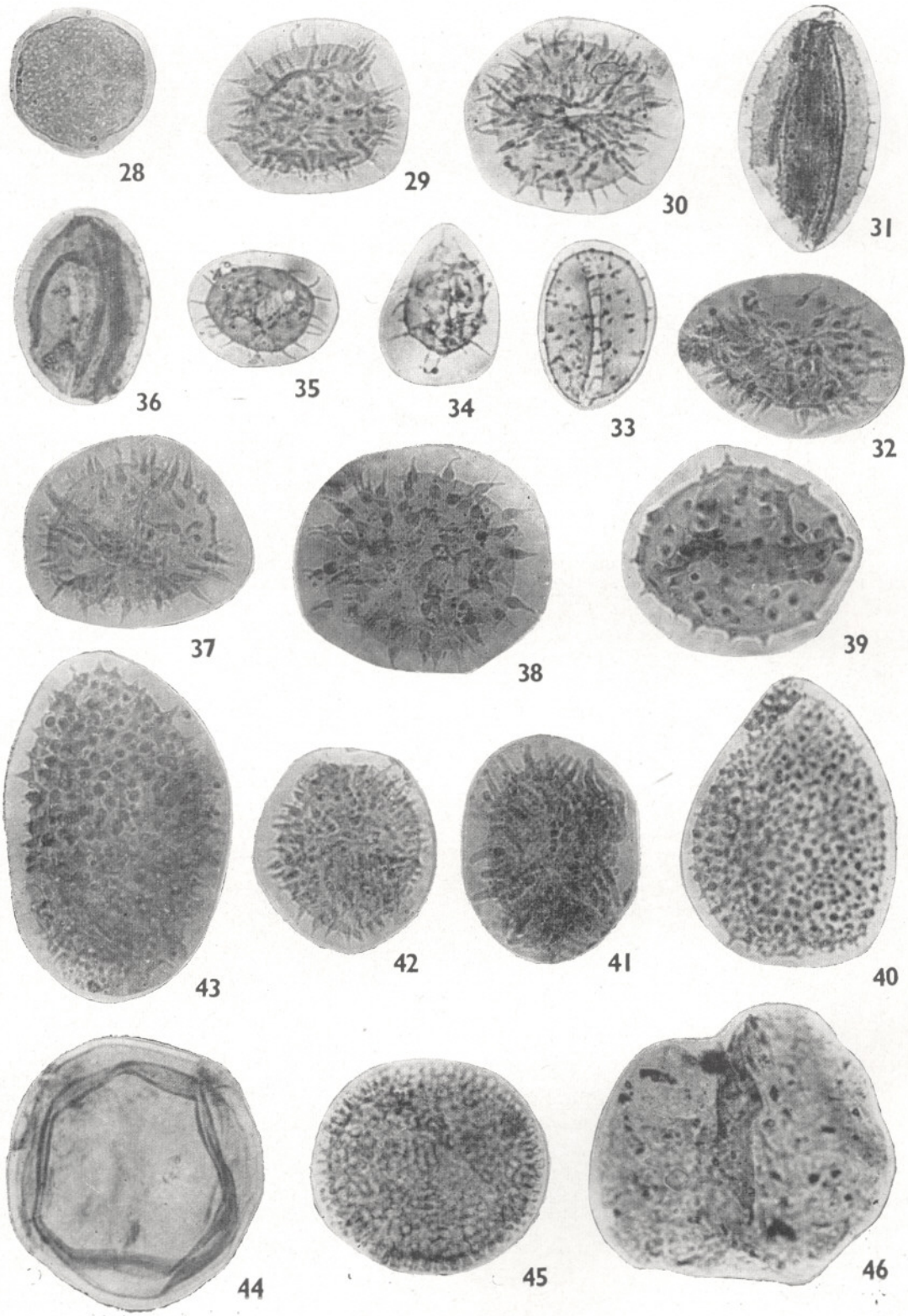
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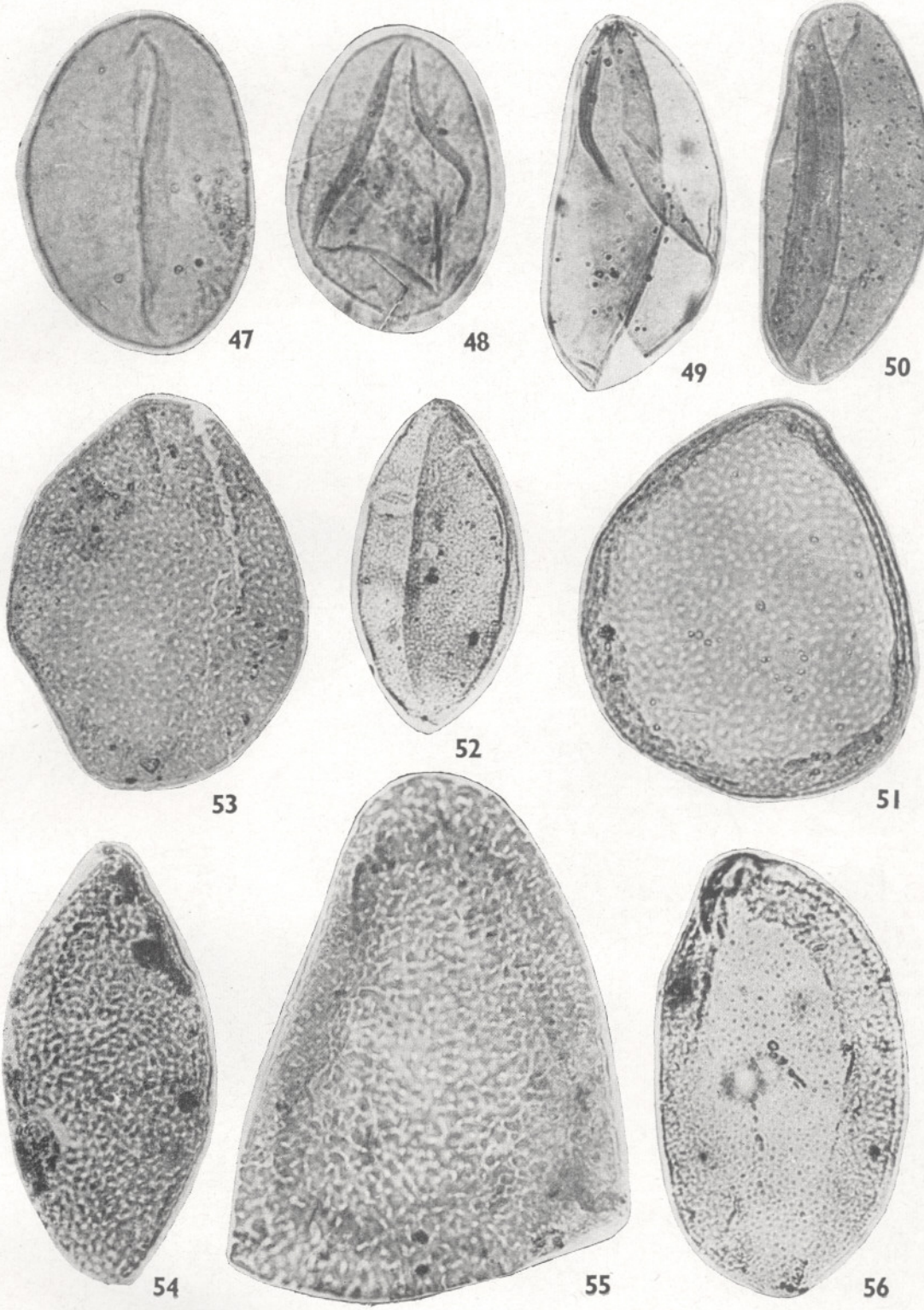
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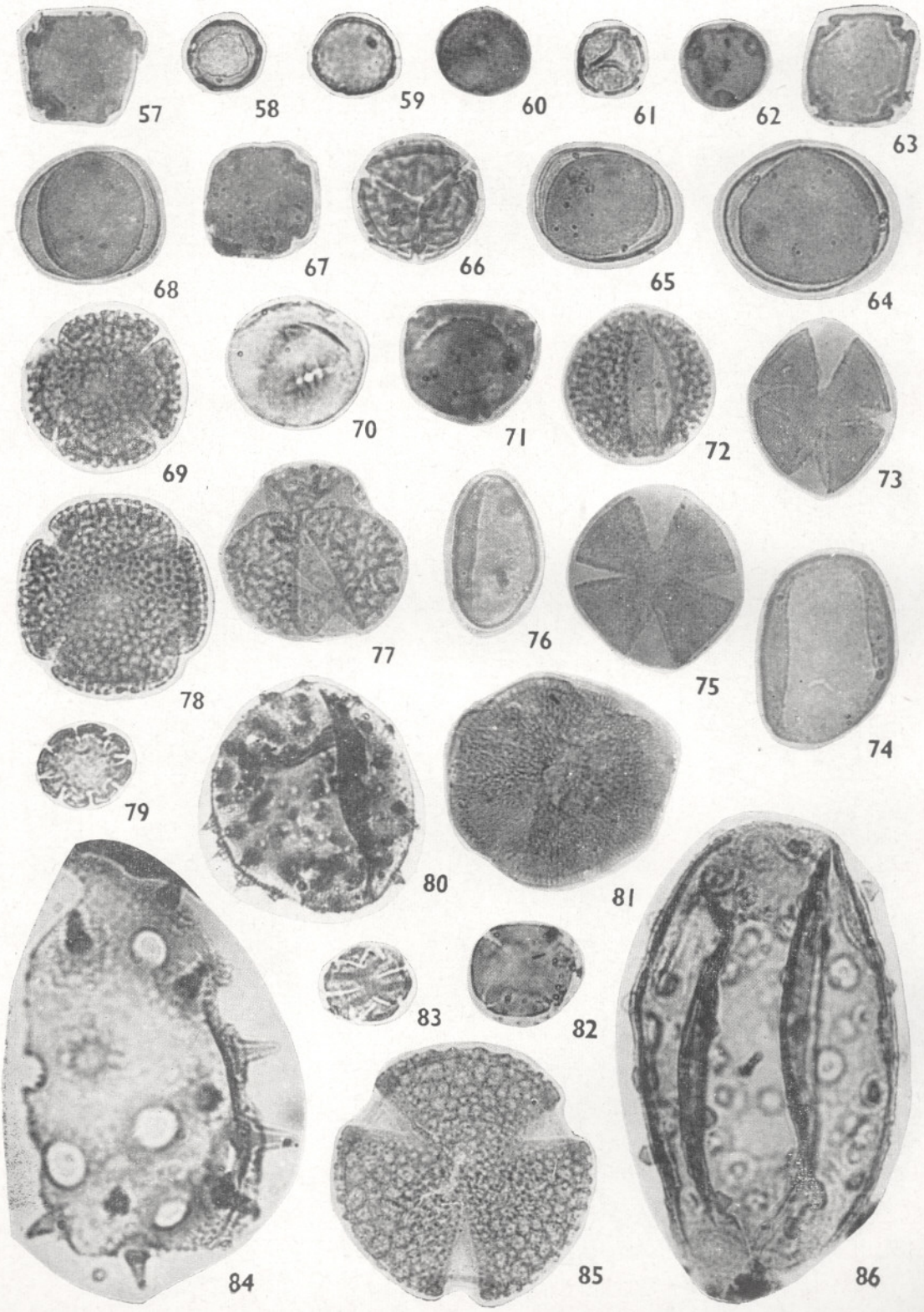
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21. *Cicatricosisporites macrocostatus* Sah & Dutta; Slide no. 3688.
22. *Gleicheniidites* sp.; Slide no. 4858.
24. *Monolites* sp.; Slide no. 4890.
25. *Todisporites* sp.; Slide no. 4888.
26. *Monolites* sp. cf. *M. discordatus* Potonié; Slide no. 4899.
27. *Lygodiumsporites eocenicus* Sah & Dutta; Slide no. 4892.

PLATE 2

28. *Assamialetes* sp.; Slide no. 4709.
29, 30. *Couperipollis* sp.; cf. *C. wodehousei* Venkatachala & Kar; Slide nos. 4899 & 4893.
31, 36. *Couperipollis duttae* sp. nov.; Slide nos. 4666 (Holotype) & 4872.
32, 37, 38. *Couperipollis* sp. 1; Slide nos. 4900, 4879 & 49134.
33. *Couperipollis rarispinosus* Venkatachala & Kar; Silde no. 3655.
34, 35. *Couperipollis ovatus* sp. nov.; Slide nos. 3666, 3731 (Holotype).
39. *Couperipollis rarispinosus* Venkatachala & Kar; Slide no. 3677.
40, 43. *Couperipollis* sp. 2; Slide nos. 3889, 4880.
41. *Couperipollis wodehousei* Venkatachala & Kar; Slide no. 4911.
42. *Couperipollis brevispinosus* Venkatachala & Kar; Slide no. 4913.
44. *Laricoidites* sp.; Slide no. 4882.
45. *Retipilanopites* sp.; Slide no. 4895.
46. *Podocarpidites* sp.; Slide no. 4886.

PLATE 3

47-50. *Palmidites plicatus* sp. nov.; Slide nos. 4872, 4906, 4715 (Holotype), 4883.
51-53. *Liliacidites major* sp. nov.; Slide nos. 8474 (Holotype), 4910, 3671.
54-56. *Liliacidites giganticus* sp. nov.; Slide nos. 3655 (Holotype), 4857, 8459.

PLATE 4

57, 63, 67. *Meliapollis minutus* sp. nov.; Slide nos. 3765 (Holotype), 4905, 4856.
58, 59, 61. *Symplocospollenites granulatus* sp. nov.; Slide nos. 4721 (Holotype), 4874, 4861.
60. *Graminidites* sp. cf. *G. media* Cookson; Slide nos. 3656.
62. *Anacolosidites* sp.; Slide nos. 4854.
64, 65, 68. *Proxapertites granulatus* sp. nov.; Slide nos. 4719 (Holotype), 4720, 4721.
66. *Myrtaceidites* sp.; Slide nos. 4859.
69, 78. *Stephanocolpites tertiarus* sp. nov.; Slide nos. 3671 (Holotype), 4881.
70. Pollen type; Slide no. 3660.
71. cf. *Rhoipites* sp.; Slide no. 4901.
72, 77. *Tricolpites* sp.; Slide nos. 4854, 4902.
73, 75. *Stephanocolpites* sp. cf. *S. arcotense* Ramanujam; Slide nos. 4854, 3655.
74, 76. *Palmidites assamicus* sp. nov.; Slide nos. 4904 (Holotype), 4906.
79. *Polycolpites cooksonii* Sah & Dutta; Slide no. 4854.
80. Pollen type-2; Slide no. 4869.
81. Pollen mass; Slide no. 4891.
82. *Stephanocolpites flavatus* Venkatachala & Kar; Slide no. 4879.
83. *Polycolpites speciosus* Sah & Dutta; Slide no. 3654.
84. Pollen type-3; Slide no. 4873.
85. *Palaeocaesalpinaceaepites eocenicus* Biswas; Slide no. 4886.
86. *Malvacearumpollis* sp.; Slide no. 4875.